

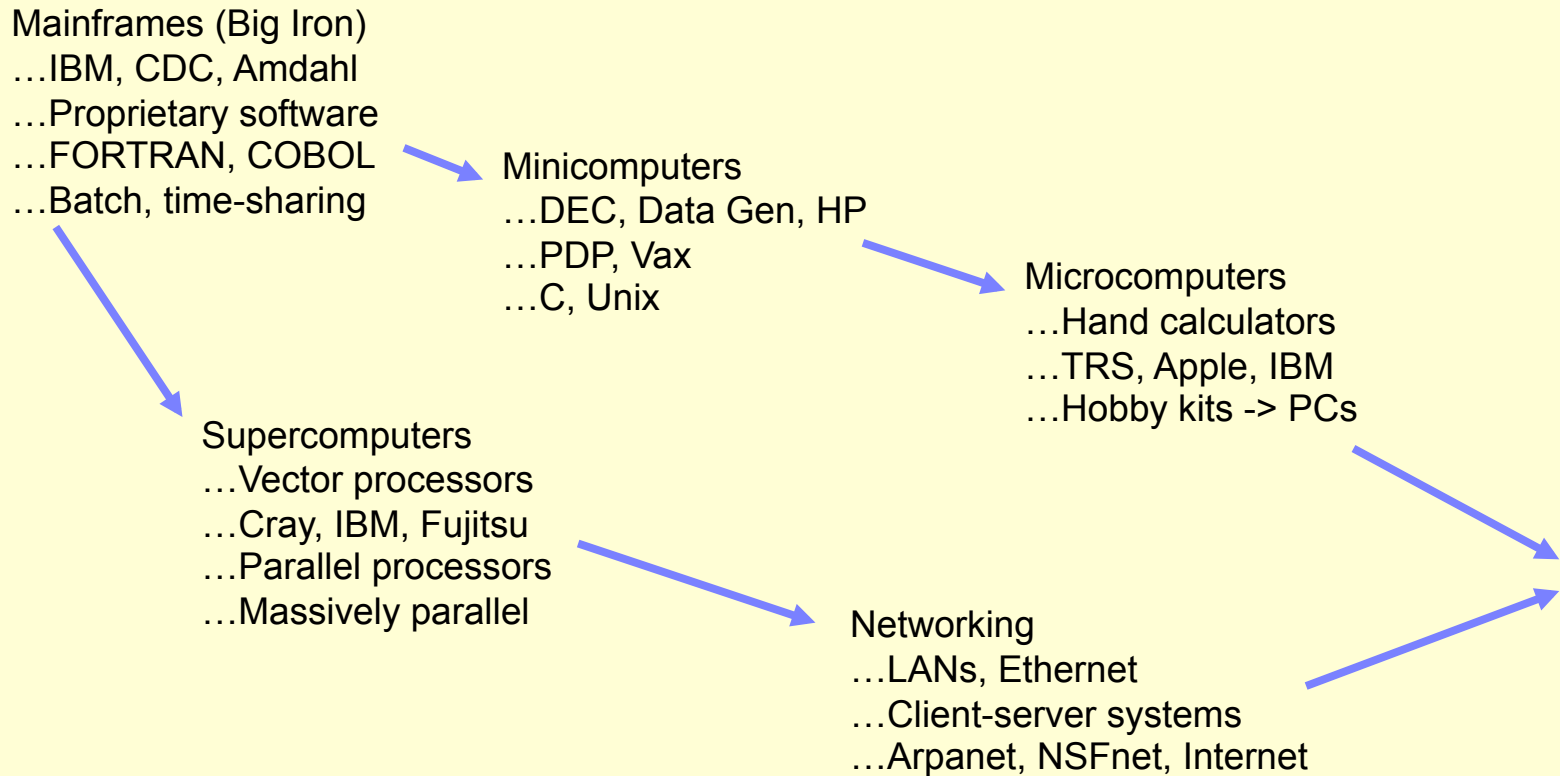
The Evolution of Information Technology



The Themes of Our Times

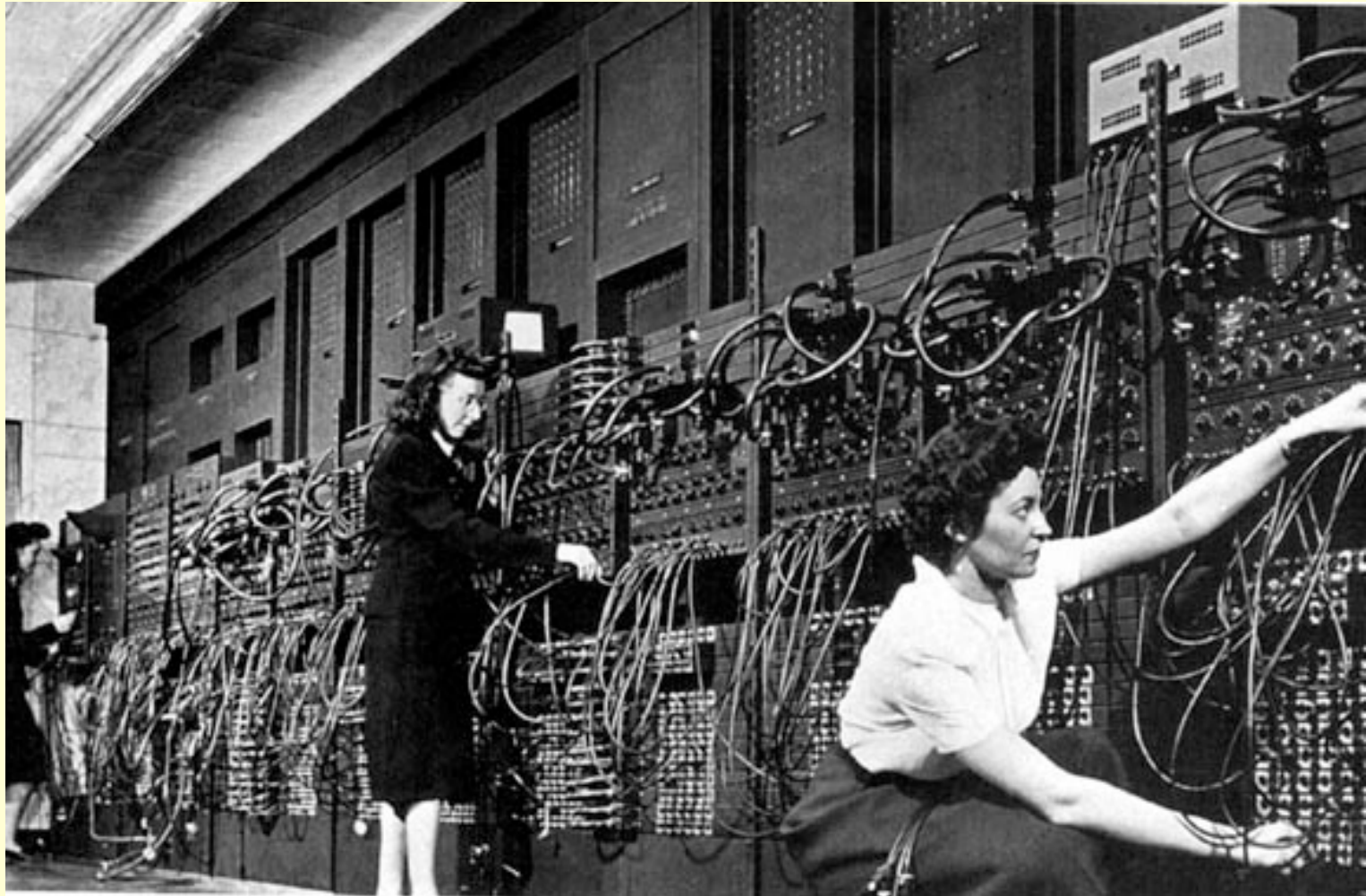
- An **Age of Knowledge**, in which educated people and their ideas have become the strategic commodities determining prosperity, security, and social well-being.
- The **global** nature of our society.
- Rapidly evolving **information technology** that reshapes, strengthens, and accelerates the activities of knowledge driven organizations.
- **Networking**, the degree to which cooperation and collaboration among individuals and institutions are replacing more formal social structures such as governments and states.

A Detour: The Evolution of Computers



Batch → Time-sharing → Personal → Collaborative

From Eniac





To ASCII "Q" ... and beyond



ASCI Platforms

PathForward
Applications
PSE
VIEWS
DisCom
Platforms
ASCI Gallery
Privacy & Legal Notice



**NPACI
Blue Horizon**



ASCI White

Platforms Help

Using ASCI White

Using ASCI
Blue-Pacific

Using ASCI Q

Using ASCI Red

Using ASCI
Blue Mountain

Using ASCI Cplant

Using NPACI
Blue Horizon
(available for special
ASCI unclassified use)

Using ASCI
Whitecap

Platforms Contacts
Mark Seager
seager@llnl.gov

James Tomkins
jltomki@sandia.gov



**ASCI
Blue Mountain**



ASCI Q



ASCI Cplant



ASCI Blue-Pacific



**ASCI
Whitecap**



ASCI Red

ASCI Purple RFP

ASCI Home

[Red's Home](#)
[Users' Home](#)
[Policies](#)
[Getting Started](#)
[Getting Help](#)
[System Status](#)
[Hardware Environment](#)
[Software Environment](#)
[Frequently Asked Questions](#)
[Running Jobs](#)
[Bonus Links](#)

[No-Frames version](#)

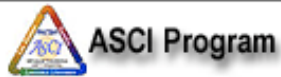
For technical information,
contact: janus-help@sandia.gov

[Privacy and Security](#)

ASCI Red Users' Guide



The hardware for ASCI Red, the world's fastest computer, is now complete, as the picture above shows. ASCI Red is a first-of-a-kind computer, and the operating software is under development, as are these web pages.



ASCI White Home

Policies

Getting Started

Getting Help

System Status


Hardware

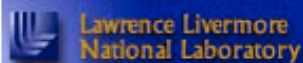
Software

Code Development

Running Jobs

Search

 View content in a new window (no frames)



[Privacy & Legal Notice](#)

UCRL-MI-138471 Rev. 1

Using ASCI White



About ASCI White...

ASCI White is the third step in the DOE's five stage Accelerated Strategic Computing Initiative (ASCI) plan to achieve a 100 TeraOP/s supercomputer system by 2004. It is part of the DOE's science-based Stockpile Stewardship Program to maintain the safety and reliability of the US nuclear stockpile without underground testing. See [ASCI White news](#) for details.

ASCI White is actually comprised of three separate systems based upon IBM's POWER3 SP technology. The largest system is a 512 node SMP (16 CPUs/node) system that is currently ranked as the world's fastest computer, with a peak speed slightly greater than 12 TeraOP/s.

The table below summarizes the systems that comprise ASCI White. For more detailed configuration and architecture information, please see the [Hardware](#) section.



LANL Consulting Help
consult@lanl.gov

ASCI@LANL Web Site
<http://www.lanl.gov/asci/>

ASC Quick Facts
<http://public.lanl.gov/consult/qsc/>

Using ASCI Q



ASCI Q is the fourth step in the DOE's five-stage Advanced Simulation and Computing (ASCI) plan to achieve a 100 TeraOP/s supercomputer system by 2004. It is part of the DOE's science-based Stockpile Stewardship Program to maintain the safety and reliability of the U.S. nuclear stockpile without underground testing.

ASCI Q, located at Los Alamos National Laboratory, comprises multiple systems based on HP/Compaq's latest technology. The first 1024-node unit of ASCI Q, FS-QA, was installed and certified July 1, 2002.

Consult **Using LANL's Parallel Q Machines (QA, QB, QSC)** [PDF] for information on accessing and using ASCI Q.





PRESENTED BY
UNIV. OF MANNHEIM
UNIV. OF TENNESSEE
NERSC/LBNL

SUBMIT YOUR SITE

SEARCH FOR:



Clusters @ TOP500

TOP500 List for November 2002

R_{max} and R_{peak} values are in GFlops. For more details about other fields, please click on the button "Explanation of the Fields"



DETAILS



EXPLANATION OF THE FIELDS

Rank	Manufacturer Computer/ Procs	R_{max} R_{peak}	Installation Site Country/Year
1	NEC Earth-Simulator/ 5120	35860.00 40960.00	<u>Earth Simulator Center</u> Japan/2002
2	Hewlett-Packard ASCI Q - AlphaServer SC ES45/1.25 GHz/ 4096	7727.00 10240.00	<u>Los Alamos National Laboratory</u> USA/2002
3	Hewlett-Packard ASCI Q - AlphaServer SC ES45/1.25 GHz/ 4096	7727.00 10240.00	<u>Los Alamos National Laboratory</u> USA/2002
4	IBM ASCI White, SP Power3 375 MHz/ 8192	7226.00 12288.00	<u>Lawrence Livermore National Laboratory</u> USA/2000
5	Linux NetworX MCR Linux Cluster Xeon 2.4 GHz - Quadrics/ 2304	5694.00 11060.00	<u>Lawrence Livermore National Laboratory</u> USA/2002
6	Hewlett-Packard AlphaServer SC ES45/1 GHz/ 3016	4463.00 6032.00	<u>Pittsburgh Supercomputing Center</u> USA/2001
7	Hewlett-Packard AlphaServer SC ES45/1 GHz/ 2560	3980.00 5120.00	<u>Commissariat a l'Energie Atomique (CEA)</u> France/2001
8	HPTi Aspen Systems, Dual Xeon 2.2 GHz - Myrinet2000/ 1536	3337.00 6758.00	<u>Forecast Systems Laboratory - NOAA</u> USA/2002
9	IBM pSeries 690 Turbo 1.3GHz/ 1280	3241.00 6656.00	<u>HPCx</u> UK/2002
10	IBM	3164.00	<u>NCAR (National Center for</u>



From super-computers to small systems





地球シミュレータセンター EARTH SIMULATOR

- Tetsuya Sato
Director - General
of ESC
- Outline of
The Earth Simulator
- Link
- Reference
- Access map

- The page only for users
(Required password)
- Registration

What's new

New

02/11/21 The Earth Simulator Center handout for SC2002

Updating history

02/11/21 Regarding International
Cooperation of the Earth
Simulator Center



Japan Earth Simulator



PN-07-12/13

PN-08-08/09

PN-09-14/15

PN-21-14/15

PN-22-14/15

PN-23-14/15

PN-24-14/15

PN-25-14/15

PN-26-14/15

PN-27-14/15

PN-28-14/15

PN-29-14/15





ASCI Purple RFP

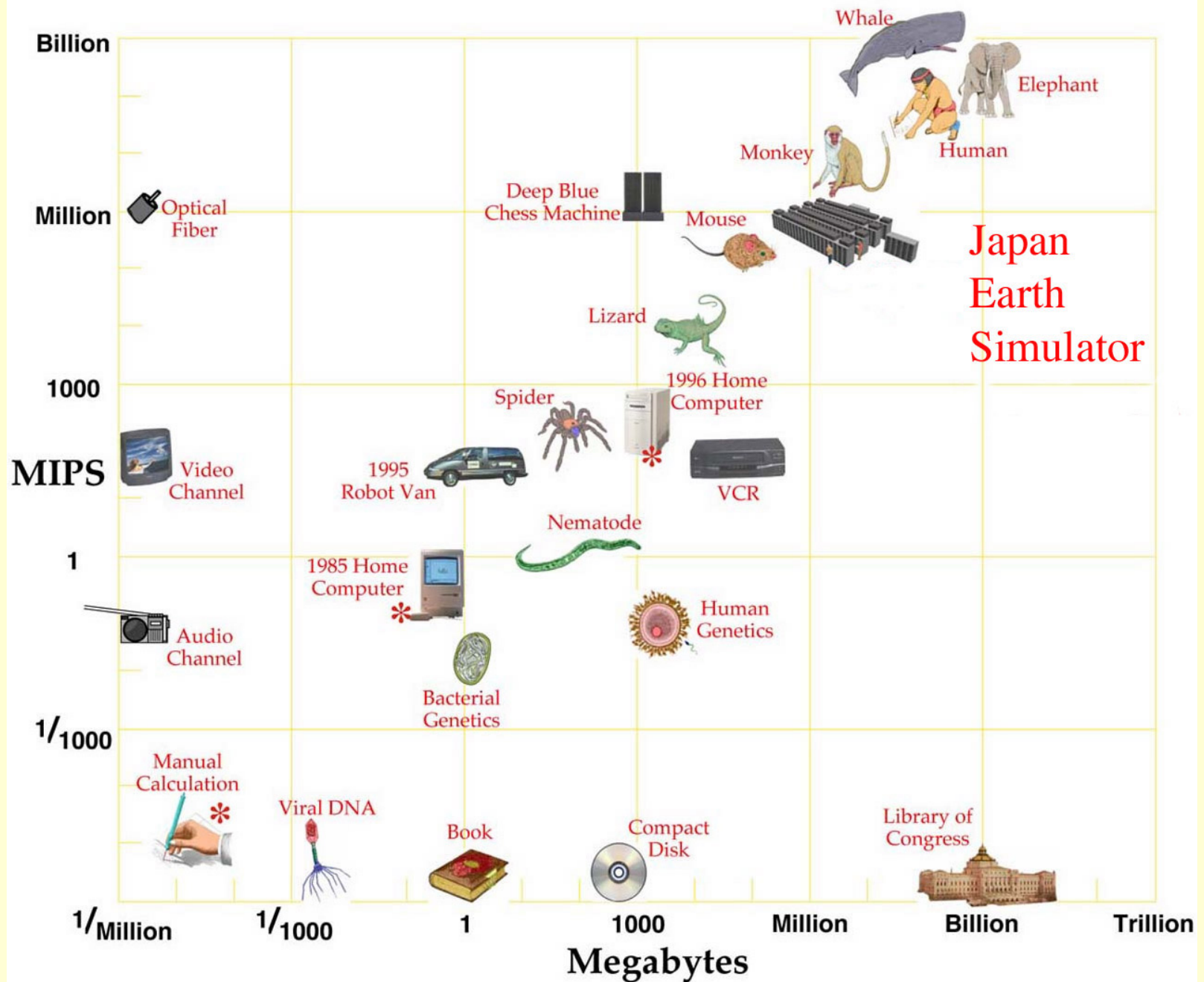


[Privacy & Legal Notice](#)

The Purple RFP was issued on February 22, 2002

**RFP RESPONSES ARE DUE 4:00 P.M. PDT APRIL 29,
2002**

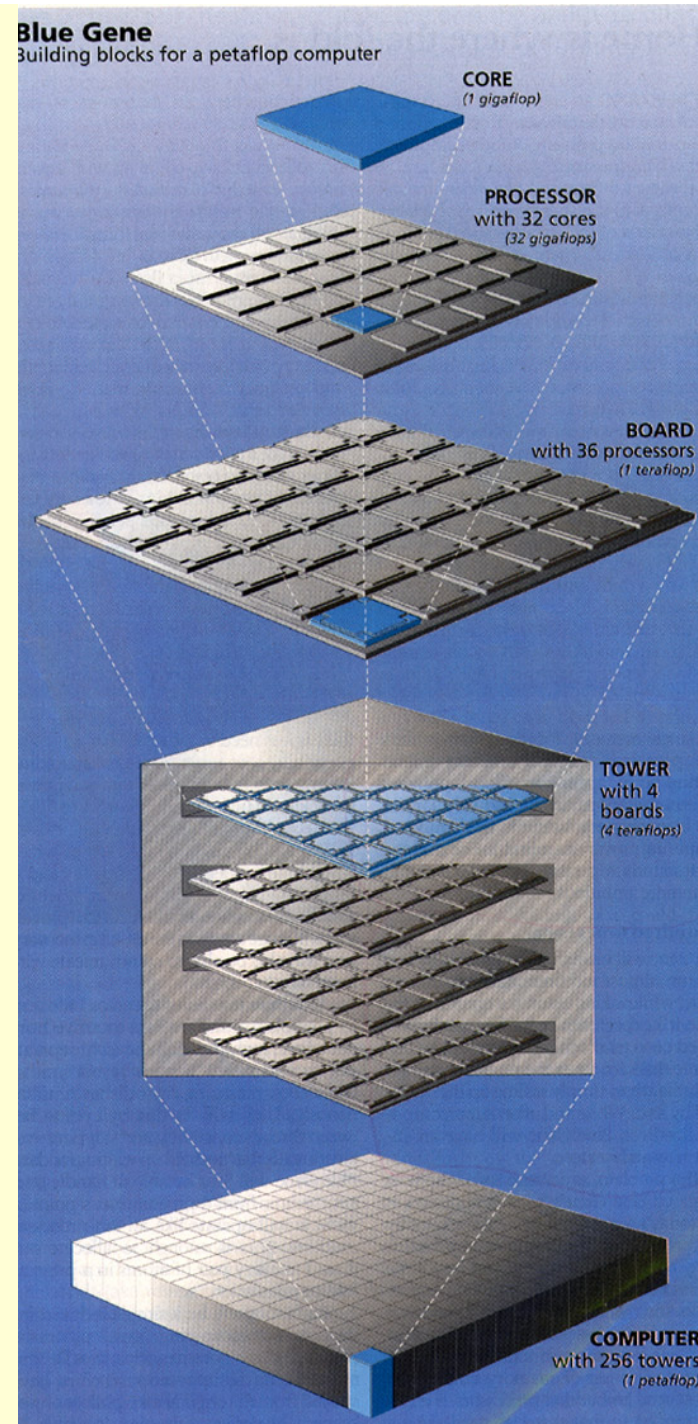
All Things, Great and Small



ASCI Purple (2004):
100 TeraFlops

IBM Blue Gene L (2004):
360 TeraFlops

IBM Blue Gene P (2006):
“Several” PetaFlops





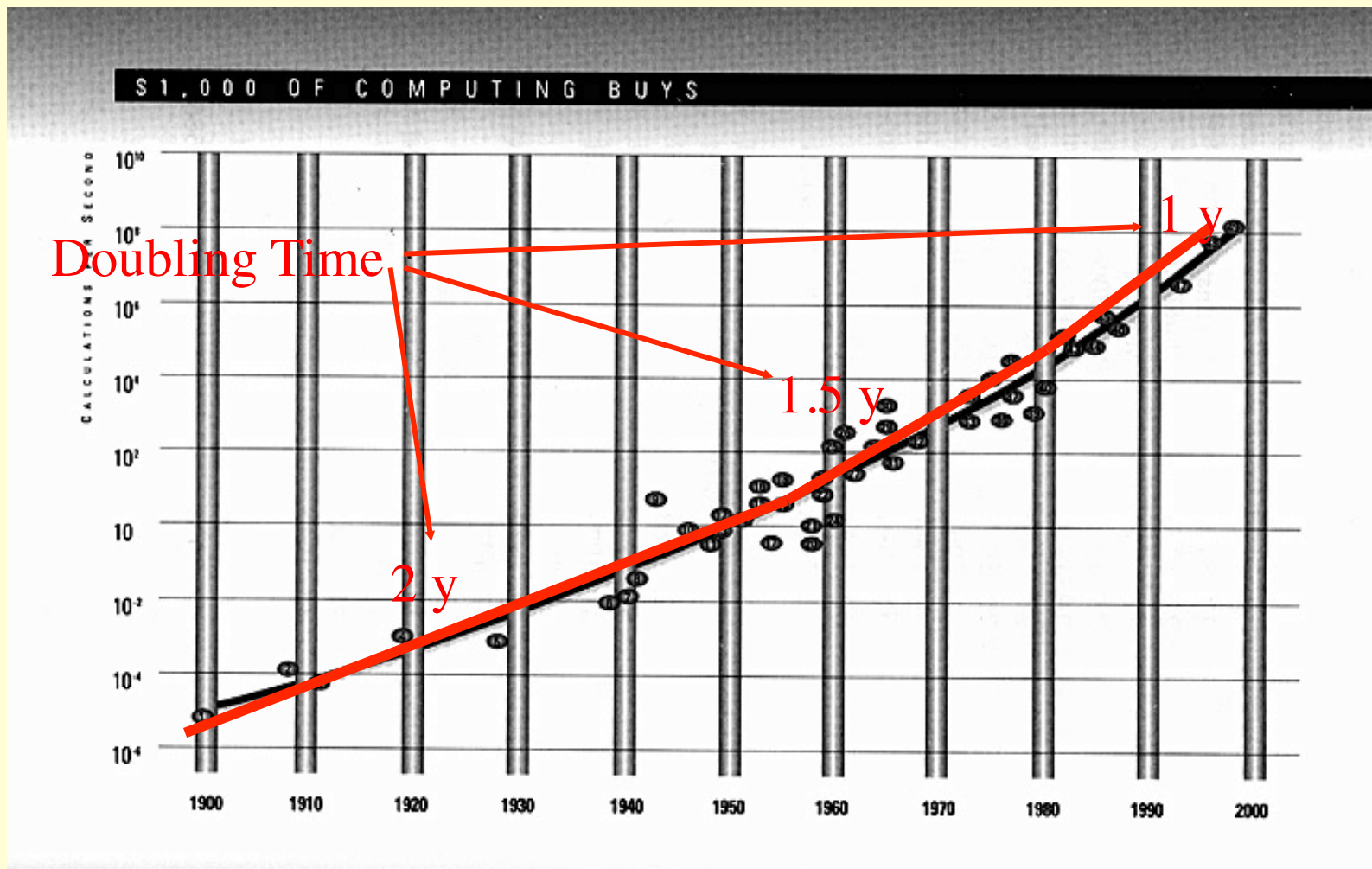








The Evolution of Computing



Some Extrapolation of the PC

	<u>2000</u>	<u>2010</u>	<u>2020</u>
Speed	10^9	10^{12}	10^{15}
RAM	10^8	10^{11}	10^{14}
Disk	10^9	10^{12}	10^{15}
LAN	10^8	10^{12}	10^{15}
Wireless	10^6	10^9	10^{12}

Some Examples

- **Speed**
 - * MHz to GHz to THz to Peta Hz
- **Memory**
 - * MB (RAM) to GB (CD,DVD) to TB (holographic)
- **Bandwidth**
 - * Kb/s (modem) to Mb/s (Ethernet) to Gb/s
 - * Internet2 (Project Abilene): 10 Gb/s
- **Networks**
 - * Copper to fiber to wireless to photonics
 - * “Fiber to the forehead...”

Hardware Technology Trends

- Processing (Moore's Law) (increasing 40% per year)
 - * Current speed record: 150 GHz chips
- Disk storage (increasing 60% to 100% per year)
 - * 3.5 disk can hold 320 Gb
 - * Far cheaper than paper or microfilm
- Bandwidth
 - * Lab demo on single fiber: 11 Tb/s
 - * Real communication at 40 Gb/s
- Mobility
 - * 802.11 (a, b, g, l) at 55 Mb/s and beyond
- Displays
 - * Full wall projections
 - * Resolution must better than paper

Software and System Trends

- Algorithm improvements
- Embodiment of techniques and processes into software
 - * Formalization and standardization
 - * People are the exception rather than the main line
- Distribution of computing, data, applications, and services
- Grid intercollection of resources
- Services as unit of IT, rather than bare-bones data and processing

Technology Directions

Technology: Today -> 2003-2006 -> 2010

- Access Bandwidth: 56 kb/s -> Mb/s -> 100 Mb/s-1 Gb/s
- Backbone Bandwidth: 155 Mb/s -> Tb/s -> Pb/s
- Intercontinental Bandwidth: 45 Mb/s -> 3 Tb/s -> many Tb/s
- Wireless: 32 kB/s -> 55 Mb/s -> Gb/s
- Enterprise database: 30 TB -> PB -> 10 PB +
- Supercomputing: 40 TFLOPS -> PFLOPS -> 100 PFLOPS
- Display: .5 Mpixel, 5. sqft -> 9 Mpixel, 60 sqft > much more

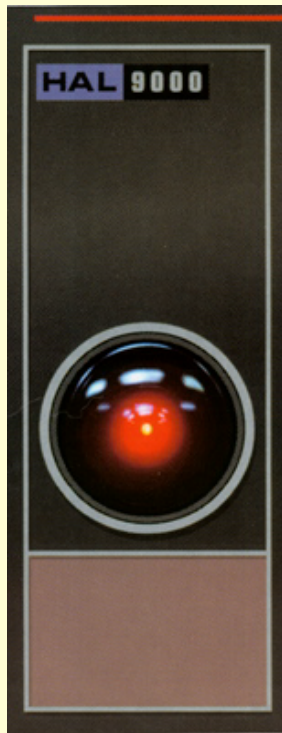
Computer-Mediated Human Interaction

- **1-D (words)**
 - * Text, e-mail, chatrooms, telephony
- **2-D (images)**
 - * Graphics, video, WWW, multimedia
- **3-D (environments)**
 - * Virtual reality, distributed virtual environments
 - * Immersive simulations, avatars
 - * Virtual communities and organizations
- **And beyond... (experiences, “sim-stim”)**
 - * Telepresence
 - * Neural implants

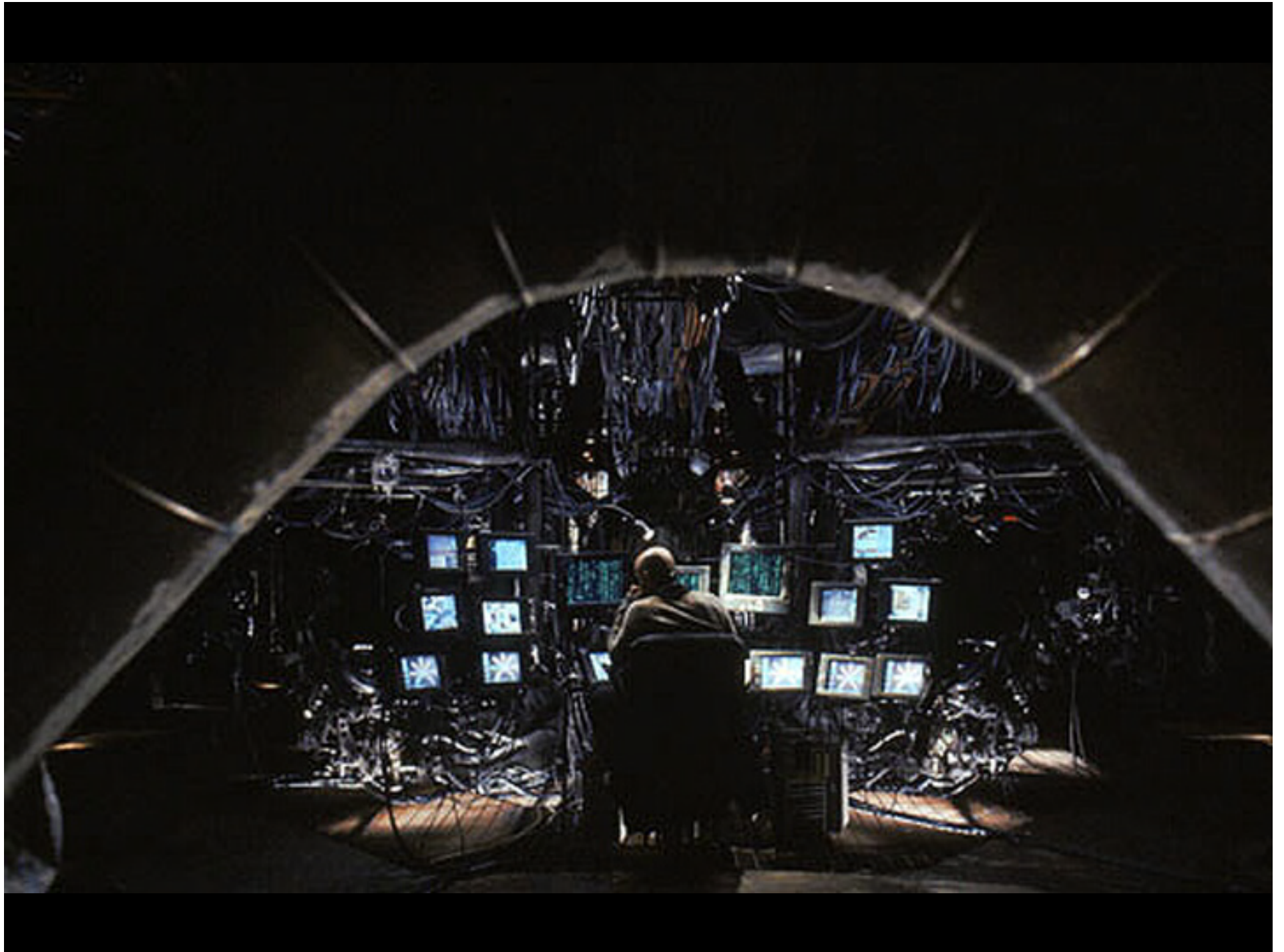
Evolution of the Net

- Already beyond human comprehension
- Incorporates ideas and mediates interactions among millions of people
- 200 million today; more than 1 billion in 2005
- Internet II, Project Abilene

Some Other Possibilities



- **Ubiquitous computing?**
 - * Computers disappear (just as electricity)
 - * Calm technology, bodynets
- **Agents and avatars?**
 - * Fusing together physical space and cyberspace
 - * Plugging the nervous system into the Net
- **Emergent behavior?**
 - * ... Self organization
 - * ... Learning capacity
 - * ... Consciousness (HAL 9000)



Cyberinfrastructure



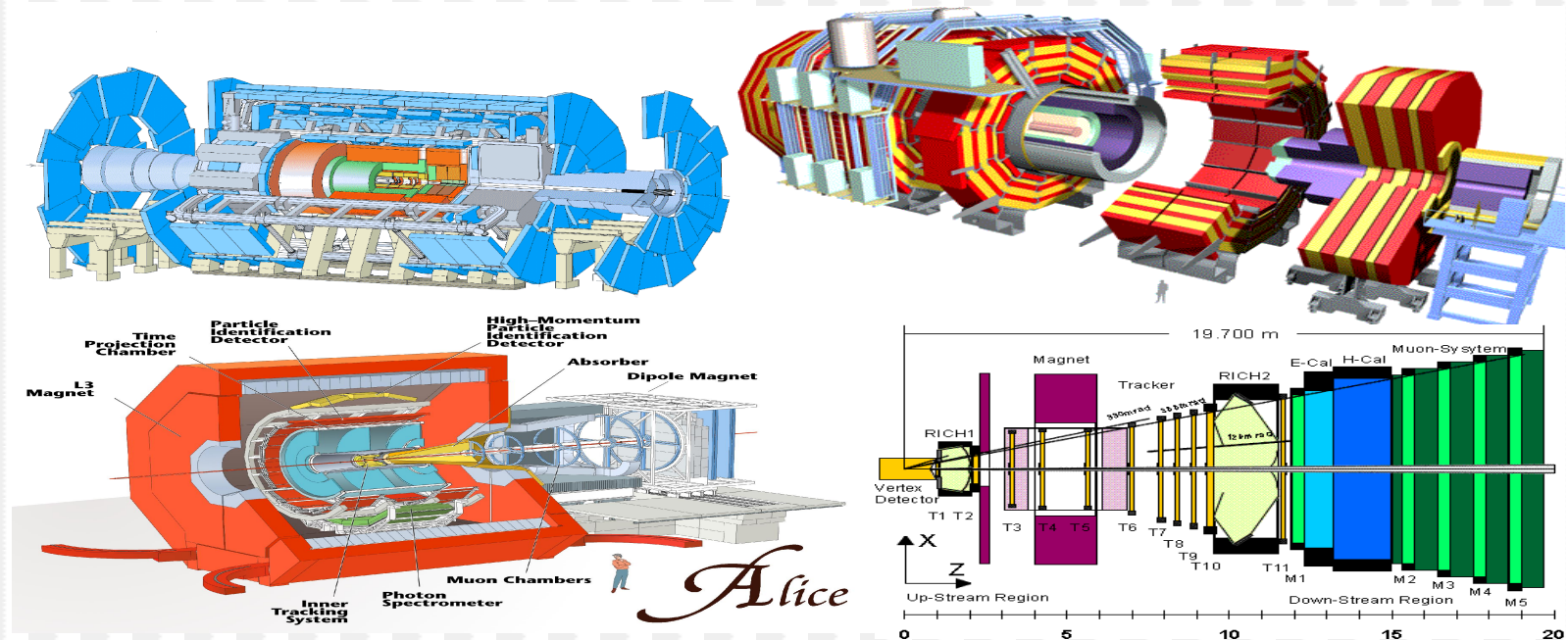
e-Science

- science increasingly done through ***distributed global collaborations*** between people, enabled by the internet
- using very large data collections, terascale computing resources and high performance visualisation
- derived from instruments and facilities controlled and shared via the infrastructure
- Scaling X1000 in processing power, data, bandwidth

Four LHC Experiments: The Petabyte to Exabyte Challenge

ATLAS, CMS, ALICE, LHCb

Higgs + New particles; Quark-Gluon Plasma; CP Violation



**Data stored
CPU**

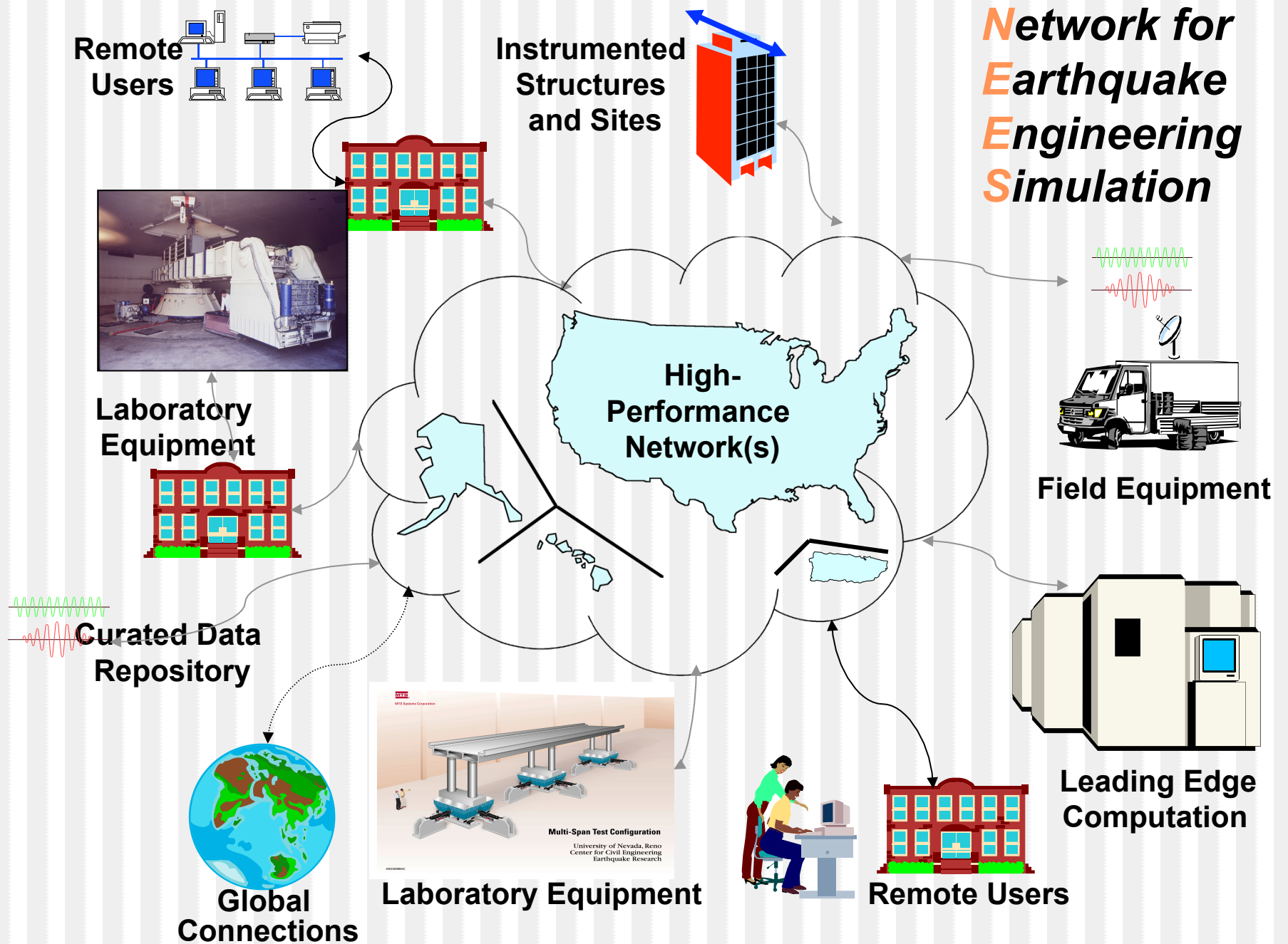
**0.1 to
(2007)**

**1
(~2012 ?)**

**~40 Petabytes/Year and UP;
0.30 Petaflops and UP**

**Exabyte (1 EB = 10^{18} Bytes)
for the LHC Experiments**

Network for Earthquake Engineering Simulation



TELESCIENCE: REMOTE ACCESS FOR DATA ACQUISITION, GRID - BASED COMPUTING, DISTRIBUTED DATA STORAGE

Project leaders:

Mark Ellisman, UCSD;
Carl Kesselman, USC;
Fran Berman, UCSD;
Rich Wolski, UCSB;

Project Manager:

Steve Peltier, UCSD

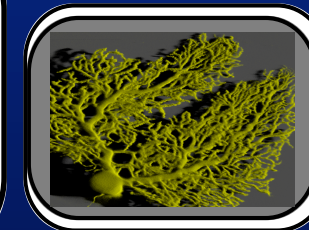
Senior Participants:

Gwen Jacobs, Montana State U.
Reagan Moore, SDSC/UCSD
Maryann Martone, UCSD/NCMIR
Amarnath Gupta, SDSC/UCSD
Bertram Ludaescher, SDSC/UCSD
Chandrijt Bajaj, U.Texas
Steve Lamont, UCSD
Shinji Shimojo, Osaka Univ.

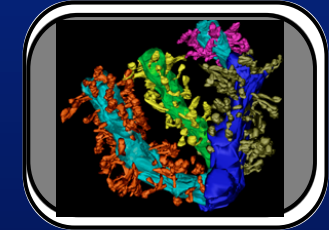
DATA ACQUISITION



PROCESSING, ANALYSIS



ADVANCED VISUALIZATION



NETWORK



IMAGING
INSTRUMENTS



COMPUTATIONAL
RESOURCES



LARGE-SCALE
DATABASES



(Cyber) infrastructure

- The term *infrastructure* has been used since the 1920's to refer collectively to the roads, bridges, rail lines, and similar public works that are required for an industrial economy to function.
- The recent term *cyberinfrastructure* refers to an infrastructure based upon computer, information and communication technology (increasingly) required for discovery, dissemination, and preservation of knowledge.
- Traditional infrastructure is required for an industrial economy. Cyberinfrastructure is required for an information economy.

Cyberinfrastructure: the Middle Layer

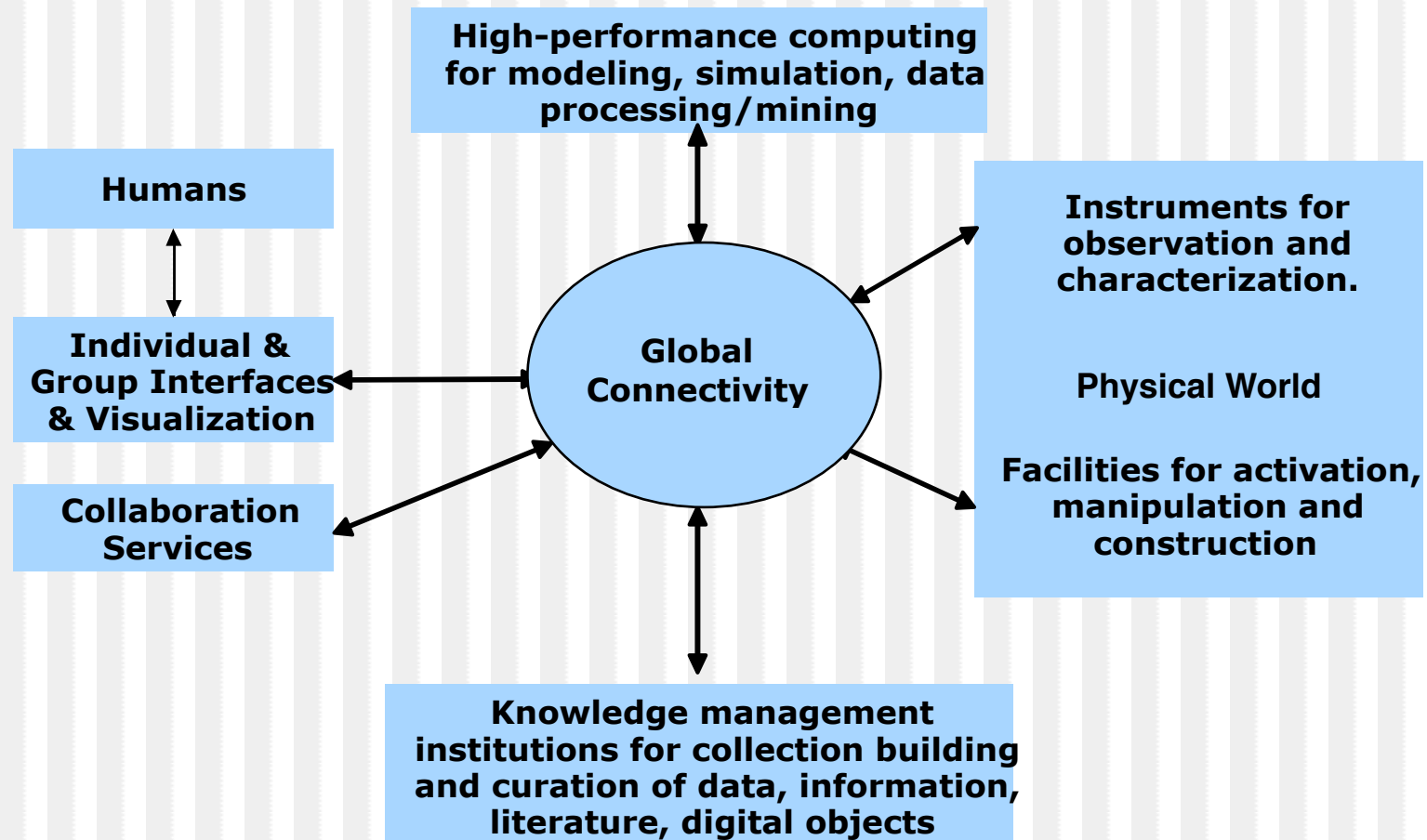
Applications in science and engineering research and education

Cyberinfrastructure: hardware, software, personnel, services, institutions

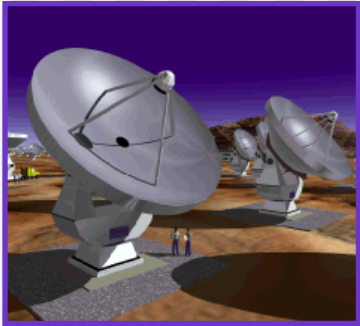
Base-technology: computation, storage, communication

Components of CI-enabled science & engineering

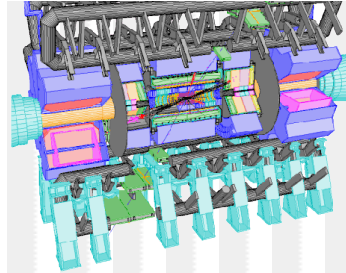
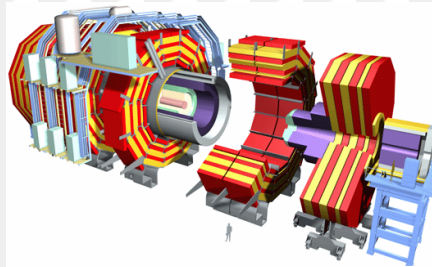
A broad, systemic, strategic conceptualization



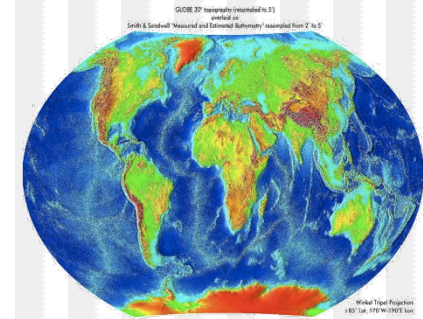
Cyberinfrastructure Enabled Science



NVO and ALMA



ATLAS and CMS



Climate Change



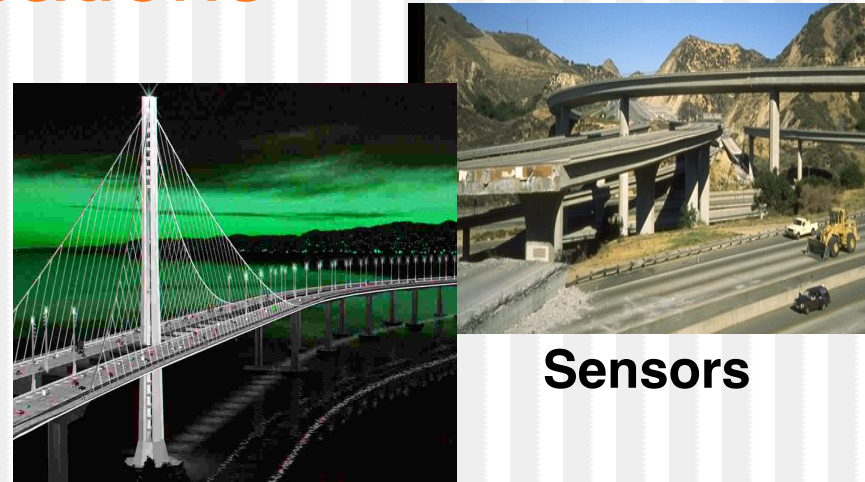
LIGO

The number of nation-scale projects is growing rapidly!

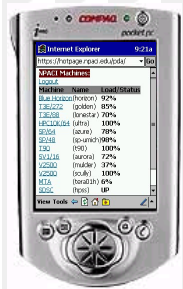
More Diversity, New Devices, New Applications



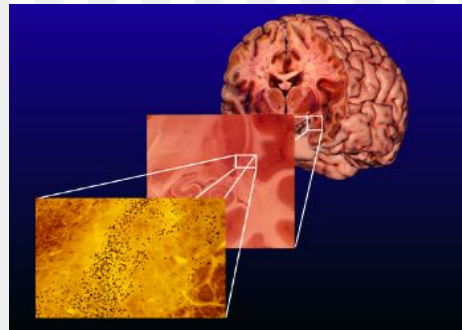
**Personalized
Medicine**



Sensors



Wireless networks

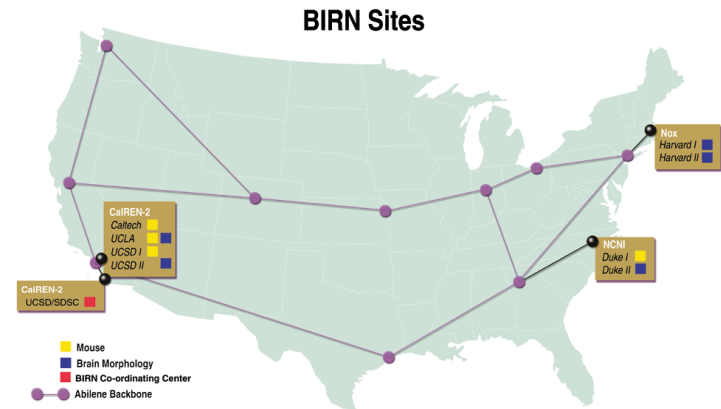
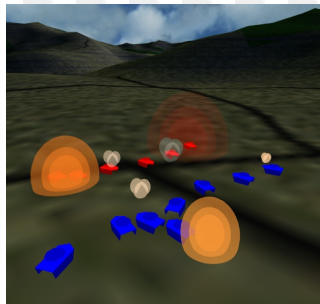
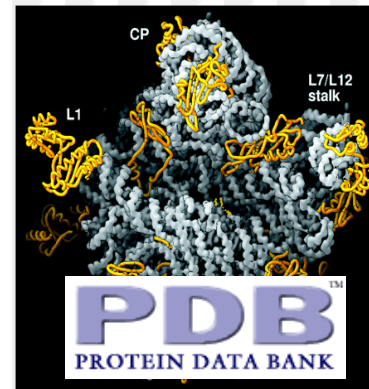
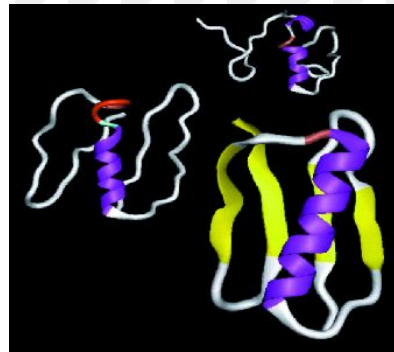


**Knowledge
from Data**

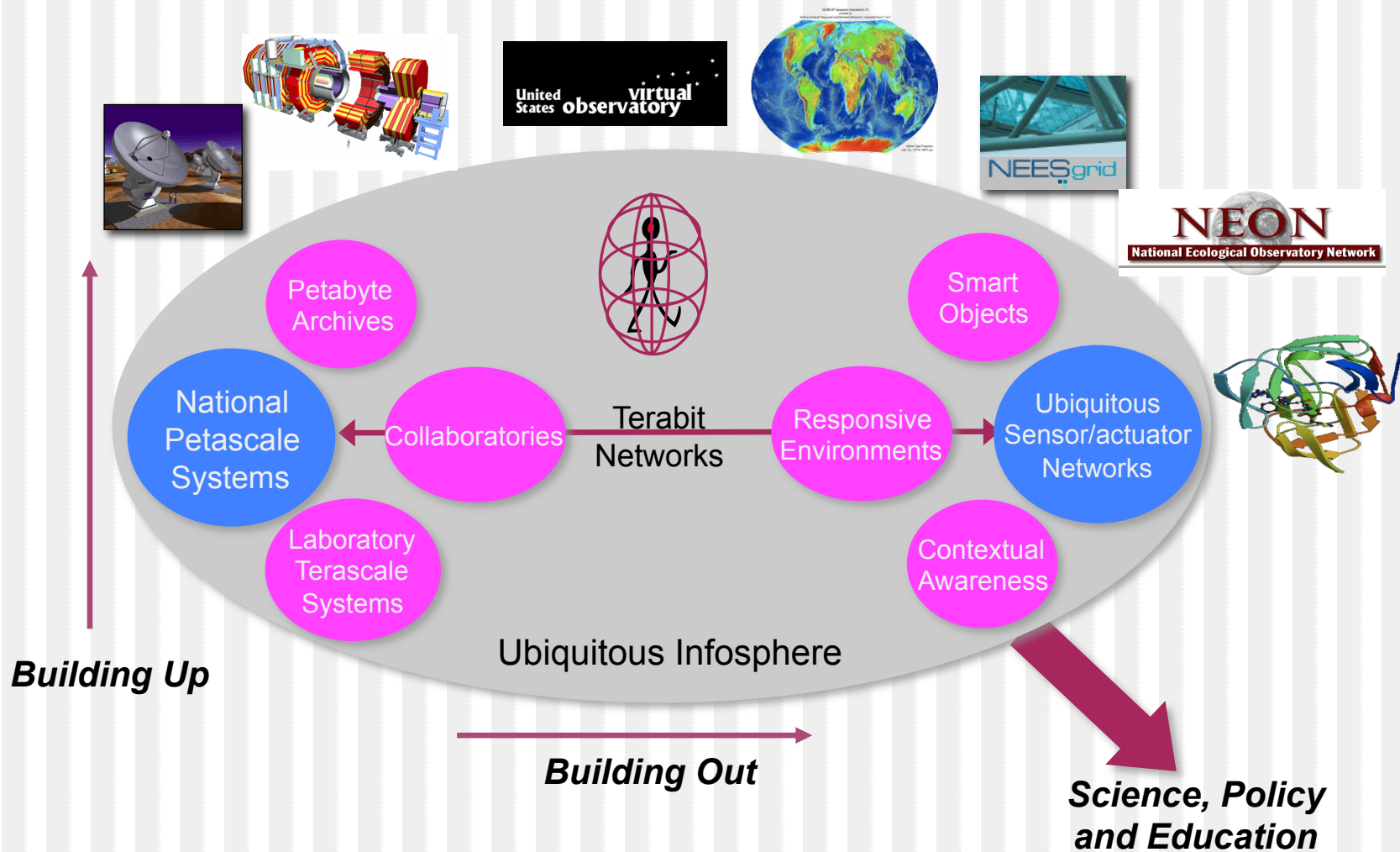


Instruments

Cyberinfrastructure is a First-Class Tool for Science



Futures: The Computing Continuum



Two leading U.S. initiatives

- Next Generation Abilene
 - Advanced Internet **backbone**
 - connects entire campus networks of the research universities
 - 10 Gbps nationally
- TeraGrid
 - **Virtual machine room** for distributed computing (Grid)
 - Connecting 4 HPC centers initially
 - Illinois: NCSA, Argonne
 - California: SDSC, Caltech
 - 4x10 Gbps: Chicago ↔ Los Angeles
- Ongoing collaboration between both projects

 Search[About Internet2](#) | [News](#) | [Members](#) | [Activities](#) | [Contact](#)[Applications](#) | [Middleware](#) | [Networks](#) | [Engineering](#) | [Partnerships](#)

About Internet2[®]

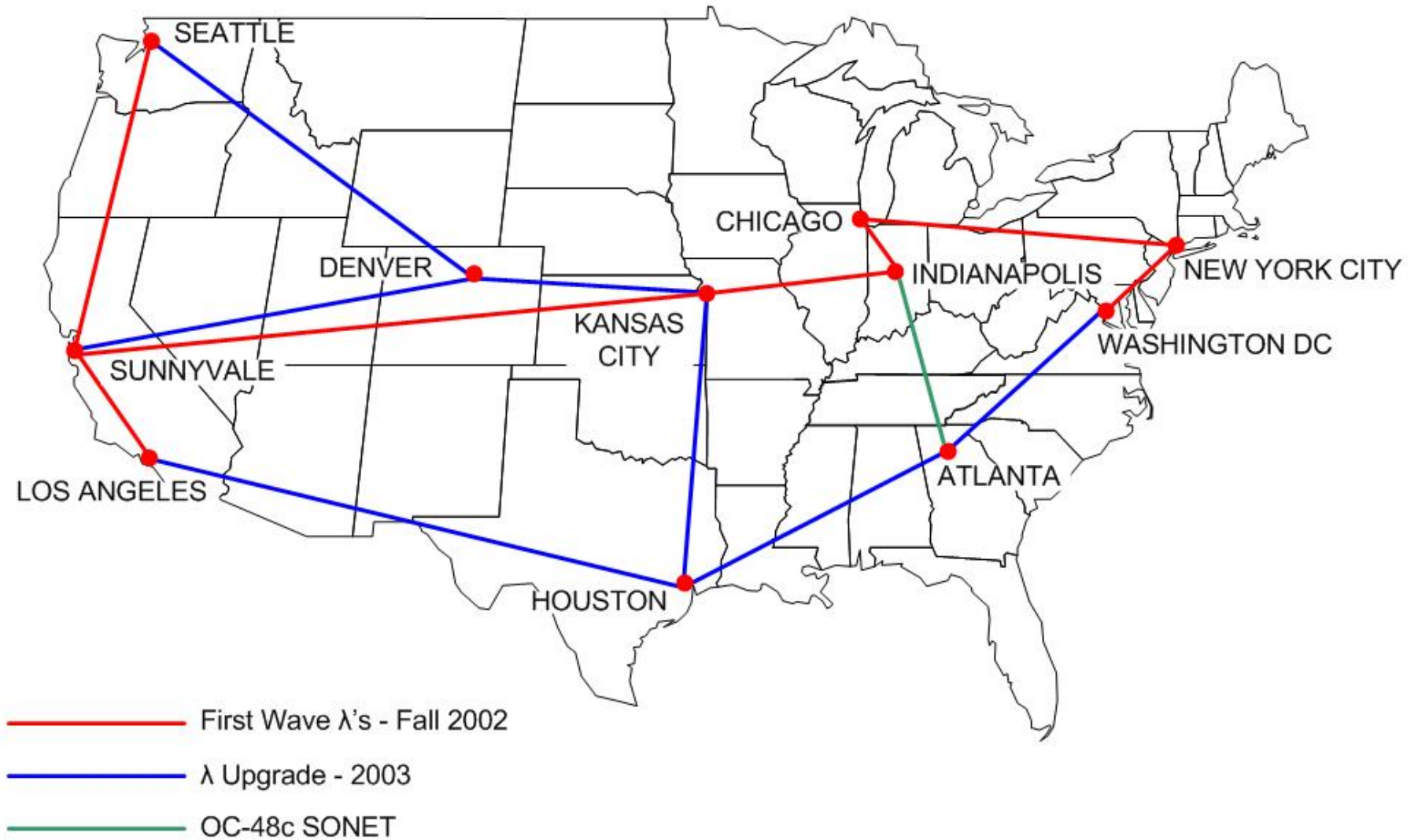
Internet2 is a consortium being led by over 200 universities working in partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet. Internet2 is recreating the partnership among academia, industry and government that fostered today's Internet in its infancy. The primary goals of Internet2 are to:

- Create a leading edge network capability for the national research community
- Enable revolutionary Internet applications
- Ensure the rapid transfer of new network services and applications to the broader Internet community.

Through [Internet2 Working Groups](#) and initiatives, Internet2 members are collaborating on:

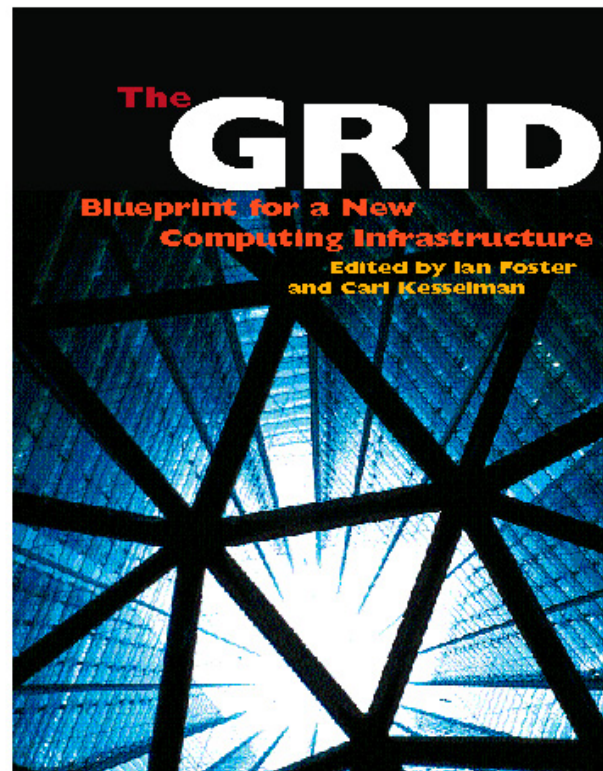
- [Advanced Applications](#)
- [Middleware](#)
- [New Networking Capabilities](#)
- [Advanced Network Infrastructure](#)
- [Partnerships and alliances](#)
- [Initiatives](#)

ABILENE NETWORK 10-Gbps OPTICAL UPGRADE - 2002-2003





The Grid



Ian Foster and Carl Kesselman, editors, "The Grid: Blueprint for a New Computing Infrastructure," Morgan Kaufmann, 1999, <http://www.mkp.com/grids>

Why Grids?

- A biochemist exploits 10,000 computers to screen 100,000 compounds in an hour
- 1,000 physicists worldwide pool resources for petaop analyses of petabytes of data
- Civil engineers collaborate to design, execute, & analyze shake table experiments
- Climate scientists visualize, annotate, & analyze terabyte simulation datasets
- An emergency response team couples real time data, weather model, population data

Why Grids? (contd)

- A multidisciplinary analysis in aerospace couples code and data in four companies
- A home user invokes architectural design functions at an application service provider
- An application service provider purchases cycles from compute cycle providers
- Scientists at a multinational company collaborate on the design of a new product
- A community group pools members' PCs to perform environmental impact study



The Grid from a Services View

Applications

Chemistry

Cosmology

Environment

Biology

High Energy Physics

**Application
Toolkits**

Distributed
Computing
Toolkit

Data-
Intensive
Applications
Toolkit

Collaborative
Applications
Toolkit

Remote
Visualization
Applications
Toolkit

Problem
Solving
Applications
Toolkit

Remote
Instrumentation
Applications
Toolkit

**Grid Services
(Middleware)**

Resource-independent and application-independent services

authentication, authorization, resource location, resource allocation, events, accounting, remote data access, information, policy, fault detection

**Grid Fabric
(Resources)**

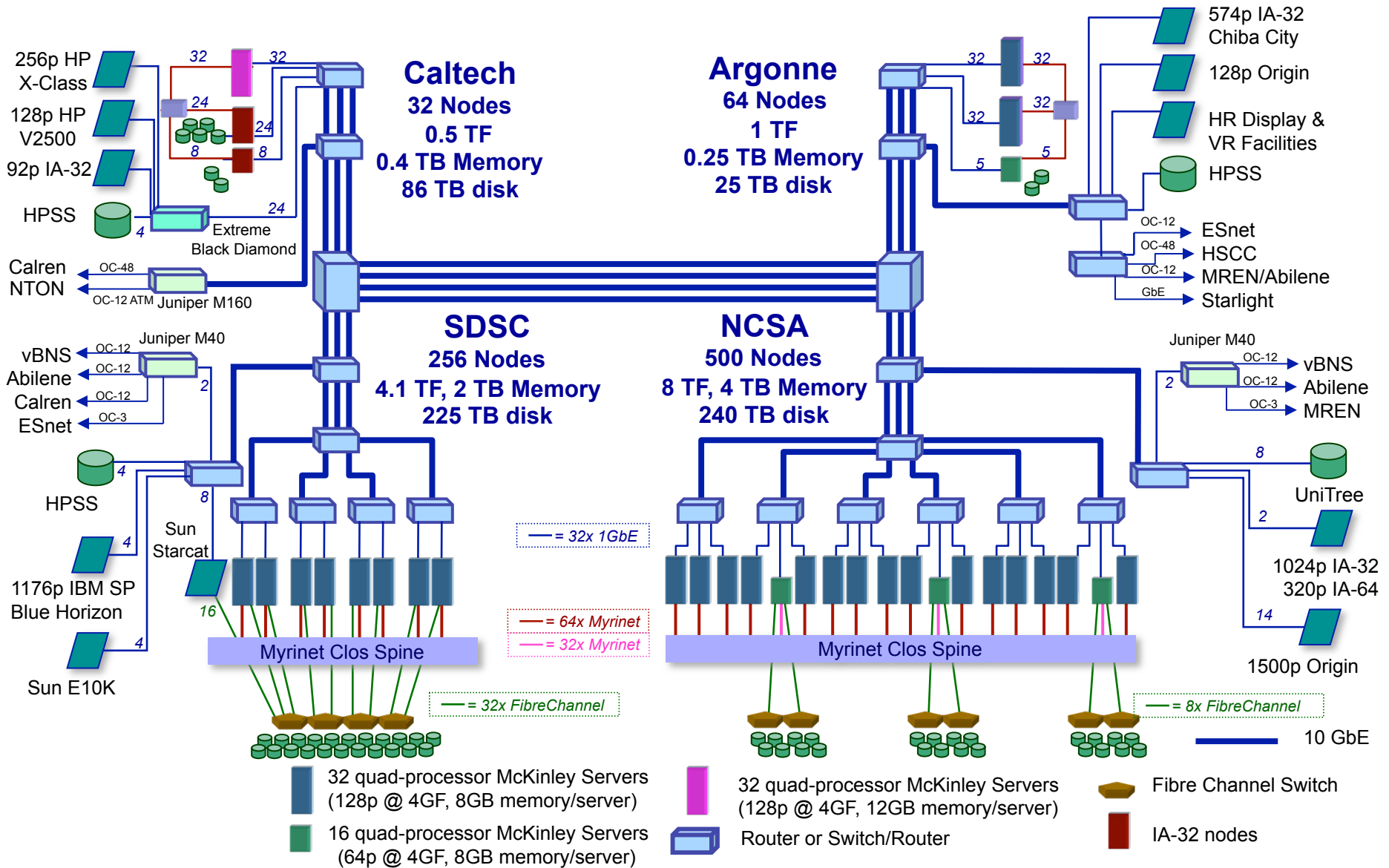
Resource-specific implementations of basic services

E.g., Transport protocols, name servers, differentiated services, CPU schedulers, public key infrastructure, site accounting, directory service, OS bypass

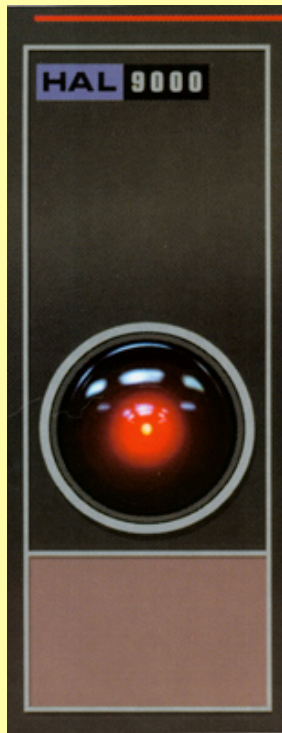
Global Data Grid Challenge

“Global scientific communities, served by networks with bandwidths varying by orders of magnitude, need to perform computationally demanding analyses of geographically distributed datasets that will grow by at least 3 orders of magnitude over the next decade, from the 100 Terabyte to the 100 Petabyte scale [from 2000 to 2007]”

TeraGrid Architecture – 13.6 TF



Some Other Possibilities

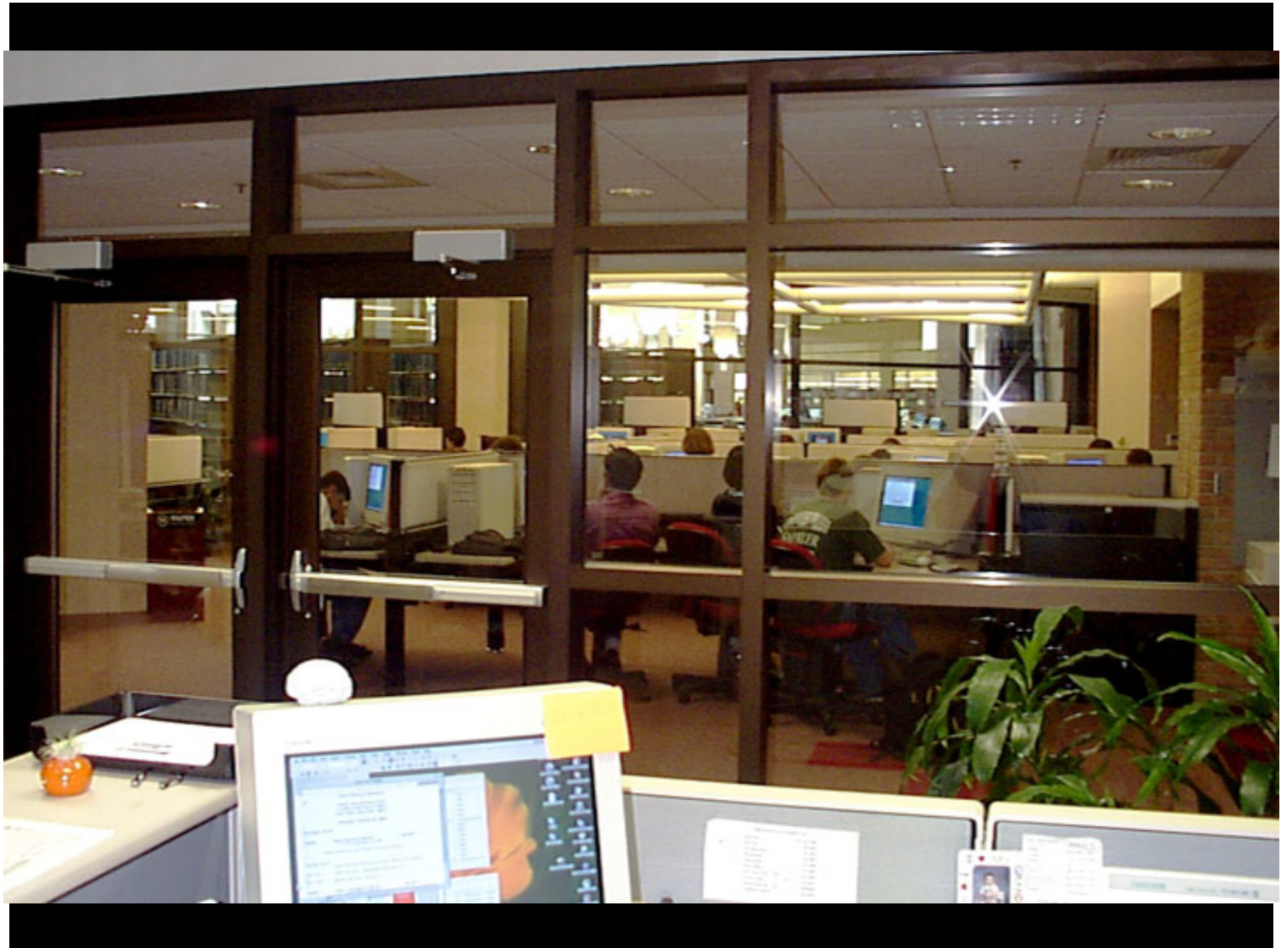


- **Ubiquitous computing?**
 - Computers disappear (just as electricity)
 - Calm technology, bodynets
- **Agents and avatars?**
 - Fusing together physical space and cyberspace
 - Plugging the nervous system into the Net
- **Emergent behavior?**
 - ... Self organization
 - ... Learning capacity
 - ... Consciousness (HAL 9000)

The Plug and Play Generation

- Raised in a media-rich environment
 - * Sesame Street, Nintendo, MTV,
 - * Home computers, WWW, MOOs, virtual reality
- Learn through participation and experimentation
- Learn through collaboration and interaction
- Nonlinear thinking, parallel processing













CAMP CAEN



The computer exploration camp from The University of Michigan. Summer 2000

















SIGN IN Sheet

http://www-personal.engin.umich.edu/~logan/...

WYSIWYG

←a href= ...to: ~@~")~(←
~ ~

Please, contact Kwanluck Ouedjeh if you find a zip diskette Thank you!









SIGN-IN
Sheet

http://www-personal.engin.umich.edu/~login_id/

WYSIWYG

mailto:~@~" (k)

Erbspi

Please
know
if you
=3
Tha

IT Forum - Carnegie Mellon

- Today's students are "electrified"; they are a transformative force.
- Example: instant messaging, WiKi's, Blog's, always on
- Peer-to-peer learning
- Faculty has concluded that best approach is to turn the kids loose, letting them define their own learning environments.

The New Literacy

- Not just from verbal to multimedia, but from “read only, listening, viewing” to composition in all media
- From analysis to synthesis: creativity!!!
- Dewey to Piaget to Papert: constructionist learning
- “I hear and I forget; I see and I remember; I do and I understand; I teach and I master!!!”

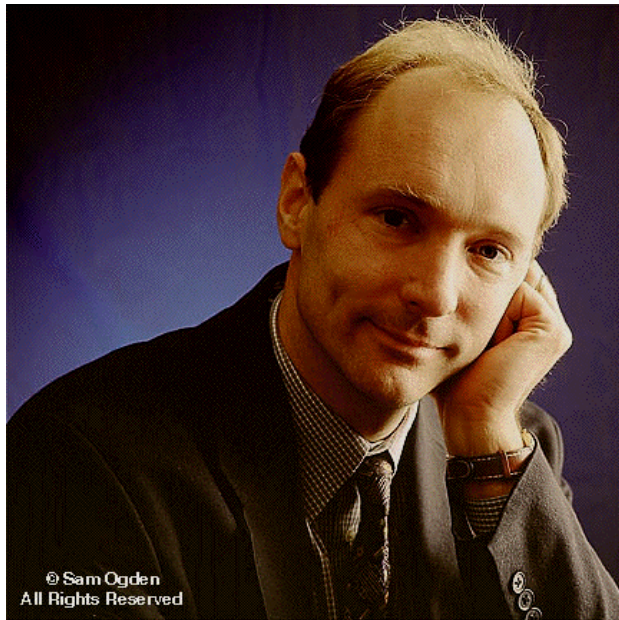
Perhaps it is time...

- To integrate the educational missions of the university with its research and service roles ...
- To rip instruction out of the classroom (or at least the lecture hall) and place it instead in the discovery environment of the laboratory or studio or the experiential environment of professional practice.

WWW and “infocern”, the 1st web address ~1990

html (xml) open standards

- A great achievement and a fantastic idea, at the right time, making the internet available to everybody
- It proves something about the benefits of assembling together urgent needs, infrastructure and smart people, and letting them interact..
- And why it is exciting to work at CERN, and in computing
- And why we should not always listen to wise people who tell us that industry will always do better than we will....



Tim Berners-Lee

To Infinity and Beyond!



“A small group of thoughtful people could change the world. Indeed, it's the only thing that ever has.”

Some Further Speculation

The Age of Spiritual Machines:

When Computers Exceed Human Intelligence

–Ray Kurzweil

2009

- A \$1,000 PC delivers Terahertz speeds
- PCs with high resolution visual displays come in a range of sizes, from those small enough to be embedded in clothing and jewelry up to the size of a thin book.
- Cables are disappearing. Communication between components uses wireless technology, as does access to the Web.
- The majority of text is created using continuous speech recognition. Also ubiquitous are language user interfaces.
- Most routine business transactions (purchases, travel, etc.) take place between a human and a virtual personality. Often the virtual personality includes an animated visual presence that looks like a human face.

2009 (continued)

- Although traditional classroom organization is still common, intelligent courseware has emerged as a common means of learning.
- Translating telephones (speech-to-speech language translation) are commonly used.
- Accelerating returns from the advance of computer technology have resulted in a continued economic expansion.
- The neo-Luddite movement is growing.

2019

- A \$1,000 PC is now approximately equal to the computational ability of the human brain.
- Computers are now largely invisible and are embedded everywhere—in walls, tables, chairs, desks, clothing, jewelry, and bodies.
- 3-D virtual reality displays, embedded in glasses and contact lenses, as well as auditory “lenses”, are used routinely as primary interfaces for communication with other persons, computers, the Web, and virtual reality.
- Most interaction with computing is through gestures and two-way natural-language spoken communication.

2019 (continued)

- Nanoengineered machines are beginning to be applied to manufacturing and process control.
- High-resolution, 3-D visual and auditory virtual reality and realistic all-encompassing tactile environments enable people to do virtually anything with anybody, regardless of physical proximity.
- Paper books or documents are rarely used and most learning is conducted through intelligent, simulated software-based teachers.
- The vast majority of transactions include a simulated person.
- Automated driving systems are now installed in most roads.

2019 (continued)

- People are beginning to have relationships with automated personalities and use them as companions, teachers, caretakers, and lovers.
- There are widespread reports of computers passing the Turing Test, although these tests do not meet the criteria established by knowledgeable observers.

2029

- A \$1,000 unit of computation now has the computation capacity of roughly 1,000 human brains.
- Permanent removable implants for the eyes and ears are now used to provide input and output between the human user and the worldwide computing network.
- Direct neural pathways have been perfected for high-bandwidth connection to the human brain. A range of neural implants is becoming available to enhance visual and auditory perception and interpretation, memory, and reasoning.
- Automated agents are now learning on their own, and significant knowledge is being created by machines with little or no human intervention.

2029 (continued)

- Computers have read all available human- and machine-generated literature and multimedia material.
- There is widespread use of all-encompassing visual, auditory, and tactile communication using direct neural connections, allowing virtual reality to take place (“sim-stim”)
- The majority of communication does not involve a human; rather it is between a human and a machine.
- There is almost no human employment in production, agriculture, or transportation. Basic life needs are available for the vast majority of the human race.

2029 (continued)

- There is a growing discussion about the legal rights of computers and what constitutes being “human”. Although computers routinely pass apparently valid forms of the Turing Test, controversy persists about whether or not machine intelligence equals human intelligence in all of its diversity.
- Machines claim to be conscious. These claims are largely accepted.

2049

- The common use of nanoproducted food, which has the correct nutritional composition and the same taste and texture of organically produced food, means that the availability of food is no longer affected by limited resources, bad weather, or spoilage.
- Nanobot swarm projections are used to create visual-auditory-tactile projections of people and objects in real reality.
- Picoengineering begins to become practical.

By 2099

- There is a strong trend toward a merger of human thinking with the world of machine intelligence that the human species initially created.
- There is no longer any clear distinction between humans and computers.
- Most conscious entities do not have a permanent physical presence.
- Machine-based intelligences derived from extended models of human intelligence claim to be human, although their brains are not based on carbon-based cellular process, but rather electronic and photonic equivalents. Most of these intelligences are not tied to a specific computational process unit. The number of software-based humans vastly exceeds those still using native neuron-cell-based computation.

By 2099 (continued)

- Even among those human intelligences still using carbon-based neurons, there is ubiquitous use of neural-implant technology, which provides enormous augmentation of human perceptual and cognitive abilities. Humans who do not utilize such implants are unable to meaningfully participate in dialogues with those who do.
- Because most information is published using standard assimilated knowledge protocols, information can be instantly understood. The goal of education, and of intelligent beings, is discovering new knowledge to learn.
- Life expectancy is no longer a viable term in relation to intelligence beings.

Many Milleniums Hence ...



Intelligent beings consider the
fate of the Universe ...

